 ODP # 81-190

Administrative - Internal Use Only

OC-M81-108
9 FEB 1981

MEMORANDUM FOR: Director of Data Processing

STAT FROM: [redacted]
Director of Communications

SUBJECT: Cable Dissemination System (CDS) Replacement

REFERENCE: ODP/Processing Computer Systems Plan, FY-81 Through FY-83, Dated 8 October 1980

1. Attached for your review is a Scope and Approach paper prepared by the OC/ODP team working on the replacement of CDS.

2. As described in the paper, the team is taking a hard look at the suitability of IBM System 370/158 hardware and software for the implementation of the new CDS. The team envisions a dual processor configuration with six megabytes of main memory and 1200 megabytes of disk storage for data. Programming support facilities and operating system options are presently being investigated.

3. Although we have not completed our evaluation of the System 370/158's suitability, a preliminary investigation suggests that this approach is feasible. For your planning purposes we would like to register our interest in hardware which might be uncommitted as a result of the processor upgrades described in the reference. The evaluation will be made as part of the project's requirements phase, scheduled for completion in June of this year. We will, of course, keep you posted as the evaluation proceeds.

STAT [redacted]

Attachment:
As stated

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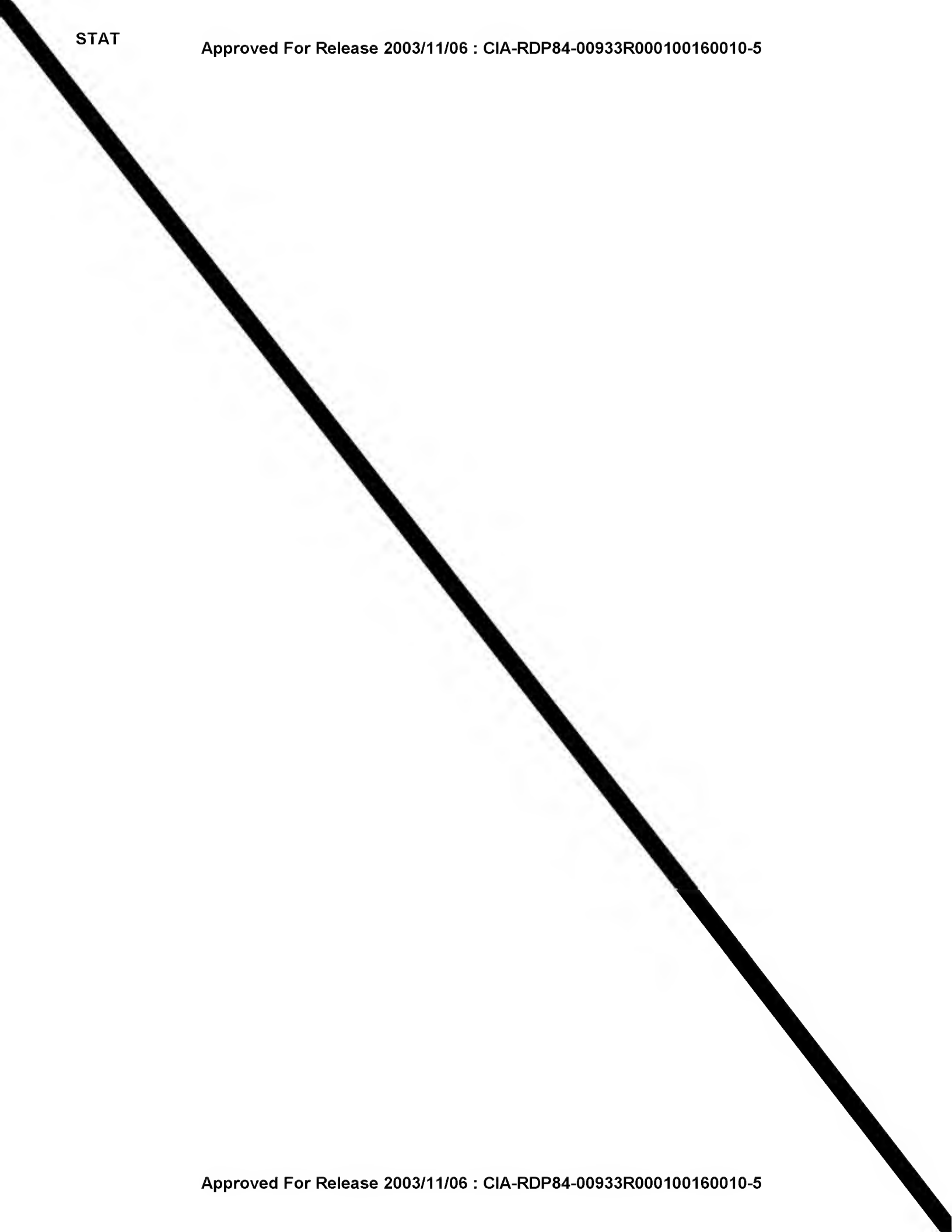
MESSAGE HANDLING FACILITY:

CDS REPLACEMENT

SCOPE AND APPROACH

DECEMBER 22, 1980

Revised January 15, 1981



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Section 1

EXECUTIVE OVERVIEW

1.1 MISSION AND SUBJECT

The mission of the Office of Communications is to provide and manage communication facilities in order that Headquarters and field elements may communicate in a secure and timely fashion with each other and with other government agencies. To support the increasing volume and variety of communication requirements anticipated in the future, the Office has already embarked on a program to replace OC's field terminal equipment and message switching centers.

This document addresses the program to replace the Cable Dissemination System (CDS). CDS is a computer system performing dissemination, printing, duplication and distribution of cables sent to or from Headquarters. Because of increasing traffic volumes, expense involved in modifying the existing system, and new requirements, CDS is expected to face difficulty satisfying all requirements placed upon it by the mid-1980's. For purposes of the following discussion, a replacement system performing CDS functions will be referred to as the Message Handling Facility (MHF).

This replacement effort is proposed as a transition from the existing configuration to an initial operational capability in a general purpose environment. This initial capability will have the flexibility to accommodate enhancement, leading to a final capability satisfying the full spectrum of cable dissemination and delivery requirements. Examples of these requirements include facilities to support the concepts of electronic cable delivery, electronic origination electronic mail systems, and on line cable storage systems performing registry and archive functions.

1.2 CURRENT SITUATION

Since the CDS functional specifications were formulated in the early 1970's, the system has been challenged by evolving user service requirements. Both hardware and software modifications have been made to CDS to meet the growing

needs. Future expansion of CDS using current hardware and software is impractical due to the limited capability of the hardware, the obsolete design, the limited availability of trained personnel, and the high labor costs and risks associated with modification to the existing software.

Cable handling systems have been developed external to CDS in order to meet the customer requirement for electrical copy as well as hard copy, to satisfy the growing need for CDS connection to other computer systems, and to ensure the timely handling of an increasing volume of traffic. Examples of these systems are: ODP's Automated Message Processing System (AMPS), which electrically distributes selected messages directly to customers' application programs via the ODP network; NFAC's Message Routing System (MRS), which sorts traffic prior to distribution, a function the Cable Secretariat performs manually; and the Automated Printing and Reproduction System (APARS), presently under development by OC, which speeds up the distribution function which is also manually handled by Cable Secretariat.

The Automated Communication Terminal - Originating (ACT-O) system, which handles formatting and editing of originating messages, predates CDS and is implemented on hardware no longer commercially supported. With the current spare parts on hand and by refurbishing its peripherals, it is projected that the ACT-O can continue to provide reliable service until the mid-1980's.

1.3 MANAGEMENT ISSUES

The major growing customer requirement on CDS is to provide electrical copy to other computer systems. This need is expected to increase as major information processing systems, such as SAFE and COMET, become fully operational. SAFE and COMET will be major users of CDS; therefore, their present and projected needs will be a part of the MHF system requirements. However, the operational dates of these systems do not effect this development as CDS can accommodate their near term requirements.

The costs of implementing the CDS and ACT-O functions in new hardware and software have not been identified, and the replacement effort today is unfunded. A joint OC/ODP team has been formed to work full-time on the MHF project.

1.4 THE DEVELOPMENT APPROACH

The development effort will be broken into the logical phases used in most large system efforts today: Problem Definition, Requirements, System Design (both preliminary and detailed), Development of Software (Programming), Testing and Acceptance of the system. This paper is the product of the problem definition phase of the effort.

The next phase, Requirements, will identify the baseline functions of the current CDS and ACT-O that must be delivered in the Initial Operating Capability (IOC) of the MHF. Additional requirements will be addressed in order to ensure the design is open-ended and flexible enough to be easily modified over the system life.

One major evaluation during the requirements phase will be the feasibility of using existing in-house ODP hardware (IBM 370/158), which will be available in the time frame needed for this system. A decision must be made early in the requirements phase in order to plan for procurement of hardware if this in-house hardware will not satisfy the requirements.

A second major consideration during the requirement phase will be the determination of the space requirement of the proposed system, due to the long lead times needed in space planning.

The system will be introduced in phases, replacing obsolete hardware with commercially-supplied equipment and expanding upon the new system as required. Therefore, the new system will be designed to operate on a family of general-purpose computers that will allow ease of future expansion to the newer faster machines without a system redesign. Software will be written in a high-level language in order to minimize development costs and to improve the maintainability of the software.

1.5 SCHEDULE

Completion of the next phase, Requirements, will be in June of 1981. The follow-on phases will be completed in the following time-frames: Design (Feb '82), Development (late '82), Test/Acceptance (mid '83).

1.6 CONCLUSION

The existing cable dissemination functions can be performed on a general purpose computer system. Transfer of these functions can occur in a timely and cost effective fashion. This OC/ODP cooperative effort will provide the Agency a new flexibility in dealing with future communication requirements.

Section 2

BACKGROUND

The interchange of electrical information between Headquarters and other members of the Intelligence Community is controlled by two computer switching centers. The Message Automated Exchange (MAX) interconnects members of the Agency's network, AXANET, and provides lines of communication to other networks. The Data Exchange (DATEX) provides a similar switching service for users who communicate data traffic, which is typically produced by and used in automated systems. DATEX also processes certain segments of narrative traffic. The Headquarters communications terminal functions are performed by the Cable Dissemination System (CDS) and the Automated Communications Terminal-Originating (ACT-O). This section describes the relationships between these systems and their present status.

2.1 INITIAL CDS DESIGN

The CDS was originally conceived as the interface between Headquarters personnel who send and receive cables and OC's switches. As such, for outgoing traffic it accepted hard copy originating traffic, converted it to electrical form, and passed it to the ACT-O for reformatting and subsequent transmission to the addressee via MAX. CDS also received incoming electrical cable traffic from MAX, analyzed the traffic and, based on the analysis, produced hard copies for each of the appropriate action and information components within the Agency. The actual analysis operation was accomplished by a combination of CDS software and decisions input from human analysts and resulted in a dissemination list. Distribution, the act of moving the disseminated messages to the customers, was routinely accomplished by printing the messages on Cable Secretariat printers, reproducing the number of copies required on Xerox machines, and manually distributing the printed copies to the customers.

2.2 REQUIREMENTS SINCE INITIAL CDS DESIGN

Since the CDS functional specifications were formulated in the early 1970's, the system has been required to cope with steadily increasing traffic volumes and increasingly sophisticated customers who need, in addition to the traditional hard-copy services, electrical distribution of cable traffic to and from applications programs residing in other computer systems. Both kinds of service must be provided in an environment of changing customer capabilities, machine to machine communications protocols, and faster response time requirements. Consequently, CDS hardware and software have undergone constant modification to improve system performance.

2.3 CDS ENHANCEMENTS

A performance study completed in 1978 identified several bottlenecks and recommended software rewrites to eliminate them. A disk upgrade was completed in 1979 which increased the system's thruput and on-line storage capacity. A provision for reserve core and an increase in computing power are the objectives of ongoing projects. Additionally, the CDS contractor, the [redacted] STAT
STAT [redacted] has announced the availability of an expanded main memory which should improve system performance and increase available reserve memory. The Office of Communications has contracted with [redacted] STAT to modify CDS for the purpose of incorporating this new memory into the system, and delivery is scheduled for spring 1982. At the conclusion of these efforts, the system should have the thruput necessary to accommodate traffic levels anticipated through the mid-1980's. While some expansion of CDS to include new functions will then be theoretically possible, only maintenance level changes will be practical because of the limited availability of trained personnel, the labor intensity required to change the system, and the risk associated with major change.

2.4 ACT-0

The ACT-0 is a companion system to CDS and handles formatting and editing of originating messages before they are sent to MAX for transmission. ACT-0 predates CDS and is implemented with processors and peripherals no longer commercially supported. A staff study completed in early 1980 examined alternatives available to prolong the lifespan of the ACT-0 hardware, which has essentially expired. Because of the historical reliability of the processor

itself and the complement of processor spares on hand, the study recommended refurbishment of the peripherals relying on moving parts for their operation (e.g.- disk and tape drives). The ACT-O system is presently operating in a reduced configuration during the initial attempts to refurbish these peripherals. When this refurbishment is complete, ACT-O is also expected to provide reliable service through the mid-1980's

2.5 OTHER SYSTEMS

For the near term (mid-1980's), then, the existing hardware and software should be able to maintain the level of service provided today. System enhancements involving minor changes in CDS function or operation will be possible but expensive. Enhancements involving functional changes will be more economically implemented in new systems supplementing CDS rather than by changing the existing hardware and software. Various customers, because of limited CDS flexibility, have implemented their own systems to improve cable delivery through electrical distribution. The primary electrical circuit for these cables is the connection to ODP. The Automated Message Processor System (AMPS) in ODP receives the cables in electronic form from CDS and then distributes them to all the customers as indicated on the CDS dissemination list. The customers are in reality computer systems and terminals within the ODP Ruffing Computer Center, e.g. OCR's COLTS (Computer On Line Text Search) and OLTA (On Line Text Analysis) data base storage and retrieval systems. One of the customers, NFAC, has developed a printing and duplicating system called the Message Routing System (MRS). As more dissemination points are recognized by MRS, the printing and duplicating services provided by Cable Secretariat for NFAC will be decreased.

2.6 NEW INITIATIVES

Initiatives to improve cable service are expected to continue to take the approach of implementing new systems in an add-on fashion to the existing facilities. Changes in CDS and ACT-O are too labor-intensive and expensive to be cost effective. As an example, the Automated Printing and Reproduction System (APARS) will take this approach. APARS is a system of computer controlled printers presently under development by OC which will result in enhancements to cable services but require no modification to CDS hardware or software. APARS will:

1. replace the present Cable Secretariat Reproduction Section printers

2. sort, print and duplicate messages

3. allow high volume users to have messages sent electrically to a remote APARS for printing rather than being printed in the Cable Secretariat

4. allow analysts at remote APARS installations to add to the CDS dissemination list before printing and sorting

5. allow for long-term storage of message traffic at the remote APARS sites for reference purposes.

APARS will not change the time CDS takes to disseminate messages but will speed the distribution process by reducing the manual duplicating and sorting requirements of the Cable Secretariat.

There is an increasing demand for CDS delivery of cables in electronic form instead of, or in addition to, hardcopy as evidenced by APARS and the proposed NFAC SAFE and DO COMET systems. Since CDS does not have usable electrical ports to service these systems, it has been proposed that CDS traffic be routed to the DATEX system. The DATEX system would then switch the cables to appropriate circuits (e.g. AMPS, SAFE, COMET and future systems). The proposed switching by DATEX is still being developed and evaluated.

Section 3

SCOPE

The scope of the MHF project is defined below in terms of an initial capability and a full capability. The full capability is described as the general direction in which the local cable handling network will evolve, and will be explored in more detail as part of the requirements phase. The initial capability is proposed as the transition to a flexible environment from which evolution to full capability can proceed.

3.1 FULL OPERATIONAL CAPABILITY (FOC)

As described in the preceeding section, the Cable Dissemination System today finds itself the center of the Agency's local cable handling network but unable to grow and change as the network requirements evolve. This evolution is proceeding in several directions:

1. Delivery--Hardcopy distribution was seen as the primary means of delivery from CDS. To support the increasing need for electrical delivery, an ad hoc network of message switches (as implemented by AMPS/MPS, DATEX and APARS) is appearing.

   MHF at FOC will fully support electrical delivery, but will do so via the MERCURY network switch. MHF will thus become a service of the general communication network, rather than a switching node for its own cable distribution network. Functions such as queueing when a delivery circuit is not operational, switching via alternate routes, etc., will be accomplished by the MERCURY network. The centralized printing of cable traffic by APARS followed by sorting and hardcopy distribution will be retained for those requirements where an electrically delivered copy is not feasible or appropriate and for backup purposes.

2. Origination-- Just as delivery, origination today is implemented by the movement of hardcopy cables. As general services become available to create, edit, coordinate and release a cable electrically, the

communication network will move messages to MHF at FOC without requiring the creation of paper. Hardcopy origination services will continue to be supported as a backup and for those cases where electric origination is not available.

3. Electronic Mail-- The MHF customer will have the ability to request delivery to any, all, or a combination of the following: a general (non-SAFE) electronic mail system, specialized information processing systems, the conventional paper mail system, and advance copy circuits (e.g.--watch offices). The electronic mail concept will be fully supported by MHF, although MHF itself will not provide the electronic mail facilities.

4. New Message Types-- With increased electrical communication capabilities in the years ahead, particularly to overseas locations, will come the requirement to reduce the quantity of information now delivered by pouch. To the extent existing policies for dissemination of cable and telepouch traffic will not apply to this information, MHF will have to have the flexibility to accommodate new cable types and dissemination policies. The transfer of information in the Headquarters area by memoranda (or any document where the originator determines full dissemination) is outside the scope of the MHF. This transfer will more appropriately be provided by a general electronic mail service and be supported by the communication network. However, for cases where document dissemination by MHF is desired, the electronic mail system can identify the document as command channel correspondence and MHF dissemination will follow.

5. Electronic Registry-- In that the MHF will not provide long term on-line storage and retrieval functions, it will not serve as a registry itself. It will, however, support the electronic registry concept. A centralized cable archive could be provided as an additional network general service function. This archive will permit centralized control of cable storage and redistribution thus preventing unnecessary duplicate storage. Due to differing requirements for individual registries and compartmentation of information, multiple electronic registries might be more practical and this concept will also be supported.

There are two possible, but radically divergent FOC implementation alternatives for the MHF. In one implementation, the MHF would continue to be the center of a

local cable handling network, essentially serving as the interface between the communications network and the various host systems or users themselves. In the other FOC implementation, the MHF would provide only a dissemination service for certain classes of information transiting the communication network. The actual interface to the host systems and to the users would be provided by the communication network.

The second implementation alternative not only eliminates duplicated effort between the communication network and the MHF, but also eliminates duplication of effort and services between the various host systems and the MHF.

The final form of the MHF depends not only on the functions it can perform but on the services available to support it, such as the communications network and the electronic mail system. These other services themselves will be changing and growing as Agency requirements change.

3.2 INITIAL OPERATIONAL CAPABILITY (IOC)

The first step in moving to this full capability is the transition from the existing configuration to a general purpose environment. The accomplishment of this transition forms an initial operating capability consisting of the CDS and ACT-O functions. IOC will provide the basis for this evolution while supporting the local cable network as CDS currently does. New functions and CDS enhancements are beyond the scope of IOC, but will be incorporated as part of the final capability. The remainder of this document addresses concerns related to the transition to the initial operational capability.

Section 4

IOC MANAGEMENT ISSUES

4.1 FUNDING

The costs of implementing the Message Handling Facility have not been estimated in detail, and the effort is presently not funded. Cost estimates will be prepared as part of the requirements phase and form the basis for requesting budget support. These estimates will address the following areas:

1. Hardware Acquisition: The present system includes a computer system, high speed printers, disks and other peripherals, a network of some fifty terminals, and front-end minicomputers. With the exception of the high speed printers, which are being replaced as part of the APARS program, the presently installed CDS and ACT-O hardware will be replaced as part of the MHF effort.

2. Development: If the project development is undertaken as a joint OC/ODP internal software effort using Agency owned hardware, these costs should consist mainly of human resources and computer time to implement the design. If the project is undertaken as an external development, funds will be required to execute the contractual cycle.

3. Installation: A significant effort will be required to prepare the Headquarters Signal Center facilities for the MHF, to perform the installation and to test the system. The magnitude of these tasks will be estimated as a coordinated effort with the [redacted] STAT

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4.2 PERSONNEL

As a joint OC/ODP project, the MHF will have personnel implications for both Offices. Prior coordination has established a full time project team of four individuals, two from each Office. This team, with the addition of a representative from the Cable Secretariat and input from the CDS and ACT-O programming staff, will carry out the tasks

defined in the requirements phase without needing significant additional personnel commitments. Personnel commitments for the remaining phases of the project will be identified in the requirements phase and will depend on the implementation chosen.

Specific short term support requirements and options will be examined in the requirements phase, but certain long term personnel requirements are independent of the implementation. The Office of Communications traditionally has maintained its computer systems at the assembly language level and relied on the computer vendor to provide systems programming, hardware/software upgrades, and most program development. With the transition to general purpose hardware and software comes the opportunity to implement new facilities in high level languages and a need for system programming support. These skills, which will be essential for long term maintenance of the MHF, are presently not available in OC. Options to acquire the skills include retraining OC personnel presently involved in assembly language programming, hiring new people, and entering into a long term support arrangement with ODP.

4.3 ORGANIZATIONAL IMPACT

The Message Handling Facility at IOC, as a replacement for CDS and ACT-O, will have little impact on traditional ways of doing business. While there will be some changes in operation and hardware visible to the Cable Secretariat, these changes should not affect the customers. Significant changes in daily operations will come, though, when electrical distribution and origination capabilities are added. As the Agency moves away from a reliance on hard copy services and toward electrical services, MHF requirements will change. MHF will not be a driving force in this move, but will be able to keep pace with and support it.

4.4 FLEXIBILITY

The flexibility to control, direct and account for the flow of electrical information in the Headquarters area is expected to become an increasingly critical management concern. Already, CDS is tasked with providing selected cable traffic to ODP users and specialized information processing systems such as SAFE, COMET and CMASS. Requirements to provide connectivity based on message content from the communications network to specialized systems will likely increase as computer hardware costs

decrease. Meeting these requirements is labor intensive, time consuming and expensive in today's environment. Therefore, the new design must be open ended and flexible to meet these growing requirements.

4.5 SECURITY

The interconnection of computer systems provides both increased risk of information compromise and opportunity to control information access. This issue will be addressed as part of the system design to ensure the access and control requirements are fully satisfied by the system.

As a part of the communications network, the MHF will be installed in the Headquarters Signal Center shielded enclosure to prevent access to information through TEMPEST. Therefore, no change in the level of TEMPEST protection provided today is envisioned. Should this existing facility not prove satisfactory for MHF installation, the location and shielded enclosure issues will have to be readdressed.

4.6 IMPACT OF NEW SYSTEMS

The next few years will see the arrival of such systems as SAFE, CRAFT and MERCURY. Each of these systems, in providing telecommunications or information processing capabilities that do not exist today, may have significant impact on the very nature of traffic in the communications network. For example, the growth of interactive communications, as supported by MERCURY and CRAFT, may reduce the use of traditional cables. However, the improved access to Headquarters data bases, as provided by SAFE, may increase the volume of traffic in the cable network. While the specific interfaces for these systems must be provided for, the MHF program makes no attempt to analyze the possible long term communications impact of these new systems.

A spin-off from the SAFE project is a wide band communications bus designed to provide end-to-end cryptographic protection and connectivity between terminals and host computers. The MHF could conceivably make use of this bus in several ways; e.g.-for general message distribution, for computer to cable analyst communication, or for advance copy distribution. The bus, now in development, may extend in some form to the Headquarters area out buildings, thus greatly expanding the number of individuals potentially having direct access to electrical distribution.

Another system presently in development is ODP's AIM (Automated Information Management System). As an electronic mail system, AIM may be an appropriate Agency wide vehicle for the origination and delivery of cables to the individual level.

4.7 IMPLEMENTATION OPTIONS

Successful implementation of the MHF can be achieved either through an internal joint OC/ODP effort, through the contracting process, or through a combination of both. In addition to the usual tradeoffs to be evaluated in comparing internal versus external efforts are some additional considerations. First, an in-house effort will provide opportunity for OC programmers (who will later be tasked with software maintenance) to become involved in and influence the development effort. Next, use of the contracting option will delay realization of the initial operating capability. This may mean the MHF cannot be brought up in advance of MERCURY, and will therefore have to compete with MERCURY for heavily committed OC resources during installation, test and acceptance. Finally, the in-house development effort timing is such that hardware (IBM 370/158) being made available by ODP can be used.

4.8 FACILITIES

The permanent location for the MHF will be in the Headquarters Signal Center, where CDS and ACT-O are presently located. Signal Center renovations to accommodate the MHF will have to be jointly addressed by the project team, [redacted] ODP's Engineering Division during the requirements phase.

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A second facilities issue concerns the disposition of the hardware between the time it is no longer required by ODP and the time it is installed in the Signal Center. Ideally, temporary facilities would be made available in order that an operational development system could be configured. If temporary facilities can not be made available, other arrangements (such as program development on the ODP systems) will have to be made for system development and test.

Section 5

APPROACH

5.1 ASSUMPTIONS

This section discusses the structured approach that will be used to replace the dissemination and distribution systems with MHF. The steps leading towards successful implementation of this system are based on the following assumptions:

1. Introduction of the new system can be accomplished in phases, replacing obsolete hardware with commercially supported equipment and expanding upon the new system from IOC to FOC as required.

2. Commercially available operating system software can be used, ensuring that as the industry adopts new techniques, standards and conventions we can keep pace by incorporating follow-on operating system releases.

3. Multiple sources will be available for system hardware and applications software.

4. Applications software can be written in a high level language, minimizing development costs and optimizing maintainability.

5. Vendor support in terms of training and maintenance will be available.

6. Sufficient manpower, budgetary resources, and space as identified in the requirements phase will be available.

5.2 PHASE DEFINITIONS

Six major phases of the project are defined which will lead to successful implementation. These phases are:

1. Problem Definition: This document is the output of the problem definition phase. The scope of the

problem has been estimated and approaches to solving the problem have been considered. The data necessary to begin the requirements phase has been gathered.

2. Requirements The requirements phase objective is to collect, specify and document the detailed goals for the replacement system. A final collection of goals, which will represent a compromise of some of the individual goals, will be identified and form the basis of the system design. An evaluation of the suitability of the available ODP hardware will be made. A Requirements document will be produced and become the baseline used for the System Design phase and the acceptance criteria.

3. System Design: For review and control purposes, system design will be broken into a preliminary and a detail design. The preliminary design will employ a hierarchical, top-down, methodology to satisfy the system requirements and be predicated on the selection of a specific hardware architecture. Gross hardware and software partitions will be made and functions assigned to each. The detailed design will further partition hardware and software into well-defined modules which can be implemented without further design. A System Design Specification will be produced and will be the baseline used for the development phase. A Test Plan and Procedures document will also be produced for use during the testing phase to insure that all requirements are satisfied by the design.

4. Development: The actual implementation of the design will take place during this phase. Software modules will be coded and tested; hardware will be acquired, tested and installed.

5. Testing/Acceptance: Testing will confirm that the individual modules perform properly together and that the design and system as implemented will satisfy the requirements. Acceptance will involve installing the replacement system and running it according to pre-established test plan to ensure confidence that the replacement will operate in a real time environment as designed.

6. IOC Operation: This will signify completion of the movement of CDS and ACT-O to a general purpose environment.

5.3 REQUIREMENTS

During the Requirements phase the following major points will be addressed:

1. the functions of the current CDS and ACT-O systems;
2. the implications of interfacing systems which communicate with or plan to communicate with CDS;
3. the physical and security constraints of the new system;
4. Cable Secretariat functions not adequately supported by the current CDS and ACT-O systems;
5. all current and proposed Agency cable dissemination/distribution systems;
6. use of cable dissemination/distribution systems in other government agencies;
7. outstanding requirements which cannot be met by the existing systems;
8. costs and benefits of using a contractor to develop the system versus in-house development;
9. confirmation that available in-house hardware will satisfy the requirements;
10. significant user problems which if not corrected will force the user to develop remedial systems.

Section 6

SCHEDULE

The MHF project being in it's infancy makes the presentation of a risk-free, accurate schedule impossible However, based on the information available at this time and assuming in-house development using available in-house hardware, a preliminary schedule is presented. A revised schedule will be produced upon completion of the Requirements phase when additional information will allow more reliable estimates.

PHASE COMPLETED	ESTIMATED COMPLETION DATE	DELIVERABLE
Problem Definition	22 December 1980	Scope/Approach Document
Requirements	15 June 1981	Requirements Document
System Design	February 1982	Design Document
Development	Late 1982	Test Bed System and Documentation
Testing/Acceptance	Mid 1983	Operational System

What are the in-house resources being assumed?

Section 7

CONCLUSION

The CDS and ACT-O systems are implemented with special purpose minicomputers designed for a relatively static environment. With decreasing hardware costs and increased information handling requirements, these systems have become the focus of all narrative information flowing to and from Headquarters. Along with these requirements have come new communication protocols and techniques which are extremely expensive to implement on our older equipment. With the end of the usable lifetime of the hardware approaching, and faced with high costs of human and financial resources to make even minor changes, it is an appropriate time to prepare for the next generation of hardware and software.

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